

Candidate Name	Centre Number	Candidate Number
		2



## GCE AS/A level

332/01

## CHEMISTRY CH2

A.M. WEDNESDAY, 3 June 2009

1½ hours

FOR EXAMINER'S USE ONLY		
Section	Question	Mark
A	1-6	
B	7	
	8	
	9	
	10	
TOTAL MARK		

### ADDITIONAL MATERIALS

In addition to this examination paper, you will need a:

- calculator;
- copy of the **Periodic Table** supplied by WJEC. Refer to it for any **relative atomic masses** you require.

### INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.

**Section A** Answer **all** questions in the spaces provided.

**Section B** Answer **all** questions in the spaces provided.

Candidates are advised to allocate their time appropriately between **Section A (10 marks)** and **Section B (56 marks)**.

### INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

The maximum mark for this paper is 66.

Your answers must be relevant and must make full use of the information given to be awarded full marks for a question.

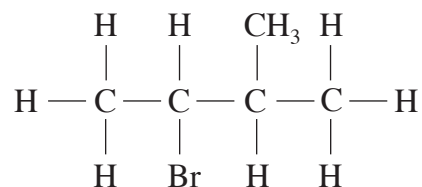
You are reminded that marking will take into account the Quality of Written Communication used in all written answers.

Page 14 may be used for rough work.

## SECTION A

Answer **all** the questions in the spaces provided.

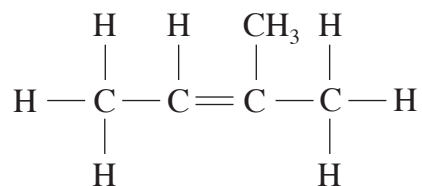
1. (a) State the systematic name of **Compound T**.



**Compound T**

..... [1]

- (b) **Compound T** reacts to form **Compound W**.



**Compound W**

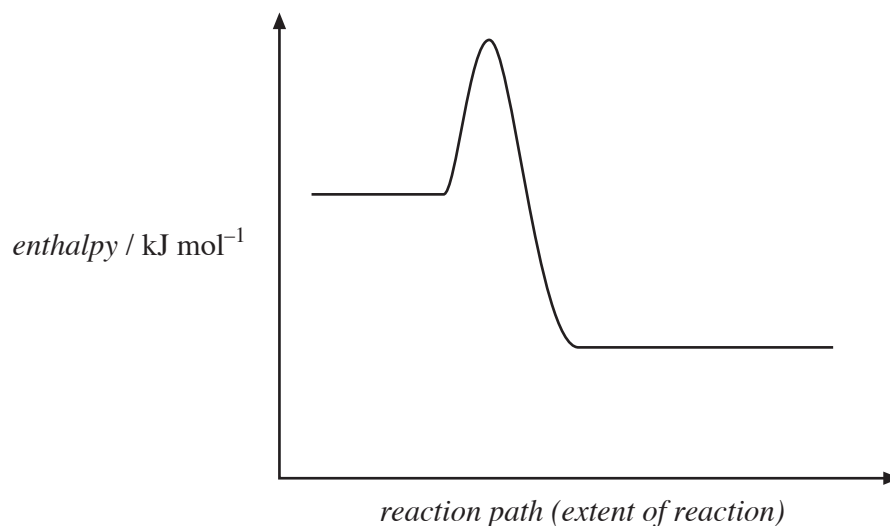
State which **one** of the following is the type of reaction that occurs when **Compound W** is made from **Compound T**.

- A Substitution
- B Addition
- C Elimination
- D Hydrolysis

..... [1]

2. The diagram below shows the reaction profile for an exothermic process. Indicate on the diagram

- (i) the activation energy,  $E_f$ , for the forward reaction and
- (ii) the overall enthalpy change,  $\Delta H$ , for the reaction.



[2]

3. Aqueous ethanoic acid,  $\text{CH}_3\text{COOH}$ , reacts with limescale (calcium carbonate) in kettles. State what you would see in this reaction and how you would confirm the identity of one of the products. [2]

Observation .....

Identification .....

.....

4. In Ancient History, the Bronze Age occurred before the Iron Age. Bronze is an alloy consisting largely of copper. Use the information in the table below, which shows the standard enthalpy of formation of two oxides, to suggest a reason for the Bronze Age occurring before the Iron Age. [2]

<i>compound</i>	$\Delta H_f^\theta / \text{kJ mol}^{-1}$
CuO(s)	-155
Fe <sub>2</sub> O <sub>3</sub> (s)	-822

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5. State which **one** of the following is the **most** soluble in water.

- A Hexan-1-ol
- B 2-Methylbutane
- C Propene
- D Propanoic acid

..... [1]

6. Silver metal is produced when silver bromide is exposed to light during photography. State **one** way, other than by changing the temperature, in which this decomposition can be made faster. [1]

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**Section A Total [10]**

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**SECTION B**

Answer **all** the questions in the spaces provided.

7. (a) Read the short account written below and then answer the questions that follow.

One method of producing a halogenoalkane is by the direct halogenation of an alkane. An example of this method is the reaction of methane with chlorine in the presence of ultraviolet light, giving chloromethane as one of the products.

This reaction is an example of free-radical substitution.

- (i) Write the equation for the reaction between methane and chlorine that gives chloromethane as one of the products. [1]

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- (ii) State what is meant by the term **substitution**. [1]

.....

- (iii) Write an equation that shows the initiation stage of this free-radical substitution. [1]

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- (iv) Explain, in terms of the reaction mechanism, how the reaction can proceed further to give dichloromethane as another product. [1]

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- (v) Chlorine reacts with propane in a similar way to methane.  
Explain how hexane,  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ , occurs as one of the products in the reaction of propane with chlorine. [2]

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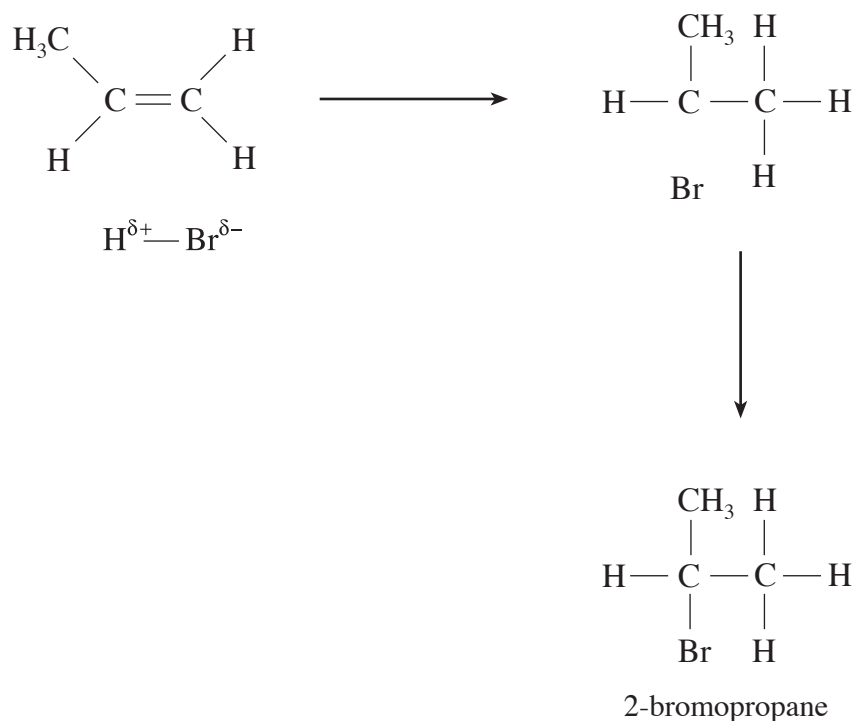
- (b) (i) The cracking of alkane hydrocarbons can also proceed by a free-radical mechanism. Complete the equation below by giving the graphic (full structural) formula of the other product that is obtained by cracking a molecule of heptane,  $C_7H_{16}$ . [1]



- (ii) Name this other product ..... [1]

- (c) Propene reacts with hydrogen bromide to give 2-bromopropane as the major product.

- (i) Using the reaction scheme below, show the mechanism of the reaction using curly arrows and full negative and positive charges as appropriate. [2]



- (ii) State briefly, why 2-bromopropane, rather than 1-bromopropane, is the main product of this reaction. [1]

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- (d) Describe, giving necessary reactants and observations, how you would detect the presence of a bromine atom in 2-bromopropane, which is a liquid at room temperature. [2]

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Total [13]

**Turn over.**

8. (a) Ethanoic acid,  $\text{CH}_3\text{COOH}$ , is made by reacting methanol with carbon monoxide in the presence of a homogeneous catalyst.



- (i) Explain what is meant by the term **homogeneous**. [1]

.....

- (ii) Write the expression for the equilibrium constant in terms of concentration,  $K_c$ , for this reaction. [1]

- (iii) This process is run at a pressure of 50 atmospheres.  
State how the value of  $K_c$  would change, if at all, if this reaction was run at a pressure of 35 atmospheres. [1]

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- (iv) The process, which is exothermic in the forward direction, is maintained at  $300^\circ\text{C}$ .  
State and explain the effect on the equilibrium yield of ethanoic acid if the reaction temperature is increased to  $450^\circ\text{C}$ . [2]

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- (b) Vinegar, an aqueous solution of ethanoic acid, is formed by the slow oxidation of aqueous ethanol in the presence of a suitable micro-organism.



- (i) Explain, in terms of the collision theory, why this reaction is fastest at the start of the process. [2]

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- (ii) Suggest a method by which the concentration of ethanoic acid in the vinegar could be determined at different stages **during** the process, other than by just measuring the pH of the mixture or by using sodium carbonate. [2]

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- (iii) A traditional method for finding the concentration of ethanoic acid in the final vinegar product is to react it with solid sodium carbonate.



In an experiment, 0.0120 mole of sodium carbonate reacted exactly with the ethanoic acid in a sample of vinegar of volume 25.0 cm<sup>3</sup>.

- I. State the number of moles of ethanoic acid present. [1]

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- II. Calculate the concentration of the ethanoic acid in mol dm<sup>-3</sup>. [1]

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- III. The concentration of vinegar is usually given as a percentage (i.e., the number of grams of ethanoic acid in 100 cm<sup>3</sup> of solution).  
Use the value obtained in II. to find the concentration of ethanoic acid ( $M_r$  60) in g dm<sup>-3</sup> and then as a percentage. [2]

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- (c) Aqueous ethanoic acid and hydrochloric acid both react with magnesium to form hydrogen. Explain why, when acids of the same concentration are added separately to identical samples of magnesium, hydrogen is given off more slowly from the ethanoic acid. [2]

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Total [15]

9. (a) Some mineral waters in Hungary contain small quantities of dissolved carbon oxysulphide, COS.

Pure carbon oxysulphide is a colourless flammable gas, which burns in air to produce carbon dioxide and sulphur dioxide gases.

- (i) Outline one environmental problem caused by each of these combustion products and state one step that can be taken to counteract each environmental problem.

*Carbon dioxide* .....

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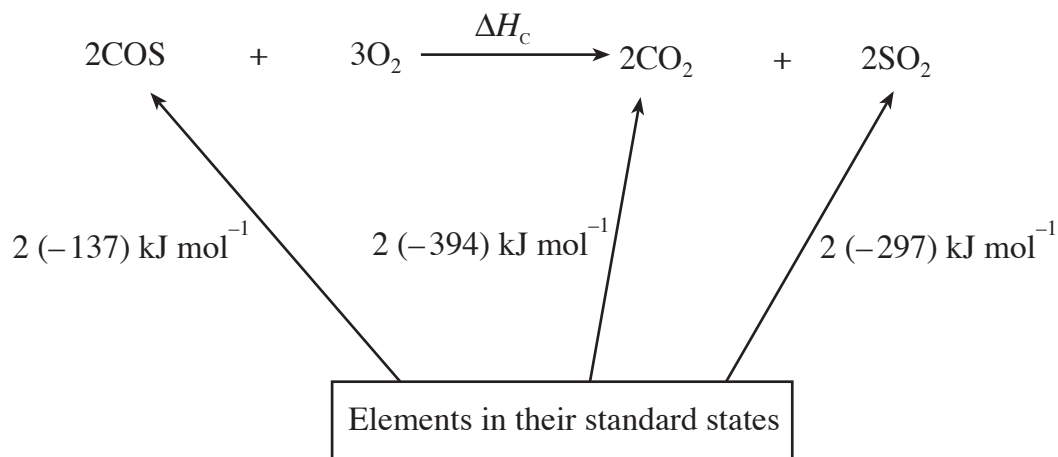
..... [2]

*Sulphur dioxide* .....

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..... [2]

- (ii) Use the values given in the enthalpy cycle below to calculate the enthalpy of combustion of carbon oxysulphide,  $\Delta H_c$ , in  $\text{kJ mol}^{-1}$ . [2]



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- (b) Ethene gas, produced by banana plants, accelerates the ripening of bananas.

- (i) State the reagent used to test for ethene and the expected observation.

*Reagent* ..... [1]

*Observation* .....

..... [1]

(ii) Ethene reacts with steam in the presence of a catalyst under suitable conditions of pressure and temperature.

I. State the type of reaction that occurs ..... [1]

II. Give the graphic (full structural) formula of the compound produced. [1]

(c) A **branched** alkene **P** contains four carbon atoms per molecule.

(i) State the **empirical** formula of the alkene.

..... [1]

(ii) State the **molecular** formula of the alkene **P**.

..... [1]

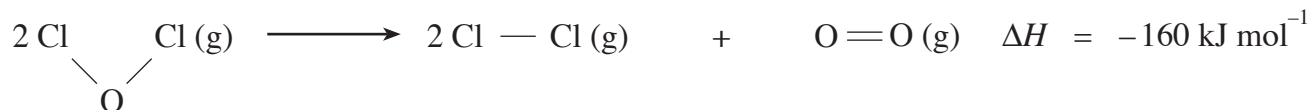
(iii) Use the information given to deduce the graphic (full structural) formula of alkene **P**. [1]

(iv) State, giving a reason, whether the alkene **P** can exist as cis-trans isomers. [2]

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Total [15]

10. (a) Chlorine(I) oxide,  $\text{Cl}_2\text{O}$ , used to bleach wood pulp, readily decomposes into chlorine and oxygen gases.



Use the enthalpy change for the reaction and the bond enthalpy values given in the table below to calculate the average bond enthalpy for the  $\text{Cl} - \text{O}$  bond. [3]

<i>Bond</i>	<i>Average bond enthalpy / kJ mol<sup>-1</sup></i>
$\text{Cl} - \text{Cl}$	242
$\text{O} = \text{O}$	498

- (b) At a certain temperature, chlorate(I) ions, used in domestic bleaches, decompose into chloride ions,  $\text{Cl}^-$ , and chlorate(V) ions,  $\text{ClO}_3^-$ .



The initial rate of formation of the chloride ion is  $2.8 \text{ mol dm}^{-3} \text{ min}^{-1}$ .

Use the equation to calculate the initial rate of decomposition of the chlorate(I) ions. [2]

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**Rough Work**

A series of horizontal dotted lines for rough work.